Making Science Thinking Visible by Engaging in Speaking and Writing

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The Sacramento Area Science Project (SASP) is an education partnership between the University of California, Davis, and California State University, Sacramento. SASP conducts research in science teaching and learning, provides science educators with useful, high quality professional development and encourages and supports teachers in being reflective practitioners focused on student understanding.

The following pages support lessons that were developed using the Science Literacy Framework[©]. These lessons are intended for teacher learning purposes and while possible for use in the classroom might require significant modifications based on teachers' instructional objectives and the level of students being served.

Understanding Natural Selection The concept of Fitness

Step #1: Problematizing Fitness

Adapted from Evolution by Natural Selection

http://serendip.brynmawr.edu/sci_edu/waldron/pdf/NaturalSelectionProtocol.pdf.

Adapted from the University of California, Los Angeles Life Sciences 1 Demonstration Manual Copyright 2005 by Jennifer Doherty and Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania

Below are descriptions of four male African lions. Examine the data and record your thinking about which lion biologists would consider the "fittest". Be prepared to explain your thinking about which is the "fittest" lion.

	George	Dwayne	Spot	Tyrone
Name				
Age at death	13 years	16 years	12 years	10 years
# of cubs fathered	19	25	20	20
# of cubs surviving to adulthood	15	14	14	19
Size (length)	10 feet	8.5 feet	9 feet	9 feet
Other information	George drove away more male lions trying to take over his family group than the other males did.	Dwayne had the most lionesses in his family group.	A fire burned Spot's home territory, and he moved his family group to a new area.	Tyrone's family group included four lionesses.

Write down your thinking -

Use the <u>Talking Sticks Protocol</u> to have a group conversation about which lion is fittest.

Talking Sticks

Each person places his or her pencil/pen in the center of the group.

- Take turns making a comment about the reading by picking up your "talking stick" and making your comment while you hold it.
- Once you are finished with your comment, set your "talking stick" in front of you and you are not allowed to comment again until all the other group members have had a turn (group members may pass their turn with the "talking stick").
- After everyone in the group has had a chance to comment, repeat the process.

Step #2: Reading and processing information about the Fitness Concept Summary Protocol

- 1. In each group, one person is chosen to keep the group on-task and all participating.
- 2. Read one paragraph silently (leader makes sure all group members know where paragraphs start and end). Each person reads silently to themselves and only when all in the group are finished with the paragraph under consideration does the group progress to the next step.
- 3. Group discusses the content of the paragraph. All group members should contribute.
- 4. Group comes to consensus about main idea(s).
- 5. Talk about how to write the main idea(s).
- 6. Each group member writes down the main idea(s).

7. Repeat steps 2 – 6 for each paragraph of the reading.

Evolution by Natural Selection (adapted from Biology, Miller and Levine, 2007)

Through observation Charles Darwin recognized in nature a process that operates in a manner similar to the way artificial selection worked on farms. Darwin called this process **natural selection** and explained its action in terms of several important observations.

Darwin observed that wild animals and plants showed variations just as domesticated animals and plants did. His field notebooks were filled with records of height, weight, claw size, tail length, and other characteristics among members of the same species. Darwin did not understand the reasons for these variations, but he realized that many of them were inherited.

Darwin observed that high birthrates and a shortage of life's necessities forced organisms into a constant "**struggle for existence**", both against the environment and against each other. Plant stems grow tall in search of sunlight; plant roots go deep in the soil in search of water and nutrients. Animals compete for food and space in which to build nests and raise young. But who among all the contenders wins the struggle for existence?

Darwin knew that each individual differs from all the other members of that species. Sometimes the differences are easy to observe; sometimes differences are subtle. Individuals who characteristics are well suited to the environment survive. Individuals whose characteristics are not well suited to the environment either die or leave fewer offspring. This principle called Darwin called **survival of the fittest**.

Fitness: to survive and reproduce

Darwin was also impressed by the many different ways in which organisms survive and produce offspring. He noted that most animals and plants have body parts and behaviors that do certain things very well. The physical traits and behaviors that enable organisms to survive and reproduce in their environment give them what Darwin called **fitness**.

Darwin argued that fitness arises through a process called **adaptation**. Successful adaptations enable organisms to become better suited to their environment, better able to survive and reproduce. Darwin also used the word adaptation to describe any inherited characteristic that increases an animal's or plant's fitness for survival. Thus, the long neck and legs of a giraffe are adaptations that permit giraffes to feed on leaves of trees. With these adaptations, giraffes can eat leaves too high for most grazing animals to reach and thus are better able to survive and reproduce passing, their genes on to their young.

Each time an organism reproduces, it passes copies of its genes to its offspring. Thus, we can define evolutionary fitness as the success an organism has in passing on its genes to the next generation. And we can define an adaptation as any genetically controlled characteristic of an organism that increases its fitness.

Step #3: Applying the Fitness Concept

Review the original data on the lions in light of what you learned from the dialogues you've had and the reading.

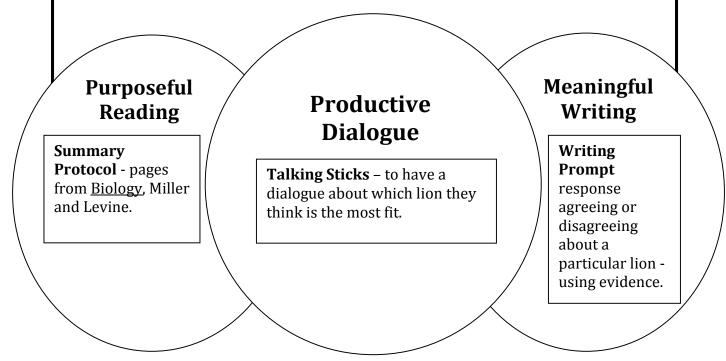
Writing Prompt:

You are a wildlife biologist working in Africa. Another biologist makes the statement that "George was the largest lion, so he had the best chance of fighting off enemies. George must have the most evolutionary fitness." Write a letter to your colleague either agreeing or disagreeing with him. In your letter make sure you support your position with evidence from the data, from text sources, and from your own thinking.

Science Literacy Framework Planning Template[©]

Engaging Science Experience Interact with data – Hands-on – Lab Activity – Inquiry Fitness Lesson

Students will work with a data set on lions from Africa (taken and adapted from a lesson from the University of Pennsylvania). They will be asked to answer a question based on their current understanding, examine data, engage with text and draw information from it, and be asked to change, explain or defend their thinking.



The lesson incorporates the parts of the Science Literacy Framework – Dialogue, Reading, and Writing to support Common Core goals in literacy to understand a scientific concept.

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